Study of Correlation of Clinical Parameters and Radiological Abnormalities in Acute Pyelonephritis in a Tertiary Care Hospital

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ABSTRACT
Pyelonephritis is a suppurative infection of the kidneys most commonly due to ascent of bacteria from lower urinary tract. Diagnosis of pyelonephritis is usually made on the basis of signs and symptoms of fever, flank pain, dysuria etc. Imaging modality (USG abdomen/CT) is required for precise diagnosis that helps in prompt diagnosis and plan necessary interventions. present study was aimed to correlate the clinical and biochemical parameters with radiological findings among patients with pyelonephritis. Study included 107 patients admitted with diagnosis of Acute Pyelonephritis The clinical and laboratory/biochemical parameters were compared with radiological abnormalities. Mean age of patients was 48.86 years, majority of them were >40 years of age, with female predominance. The mean duration of fever (days) was 8.68±6.90 days, the mean duration of Leukocytosis (days) was 6.39±3.06 days and the mean duration of hospital stay was 11.71±5.86 days. The mean TLC (Thousand x 10^3μL) was 13.88±6.17, mean CRP (mg/L) was 60.00±22.64 and the mean peak body temperature (°C) was 37.67±0.76. Diabetes was the most common comorbidity. Urine culture was positive in 83 (77.6%) participants, with E coli as most common organism isolated (n=69). AKI was observed in 58 (54.2%) patients and CKD was observed in 13 (12.1%) patients. The most common CT finding was bulky kidney with perinephric fat stranding (99.1%). EPN was observed in 29% patients. Clinical parameters in the form of duration of leukocytosis, fever and hospital stay along with biochemical parameters- total WBC counts and CRP levels correlated with hydroureteronephrosis and air foci on CT. n our study, clinical and biochemical parameters were related to hydroureteronephrosis and air foci observed in CT. These findings may help in predicting the clinical course and create a plan for treatment.

INTRODUCTION

Acute Pyelonephritis (APN), the most common upper urinary tract infection, occurs in up to 20%-35% of females with diabetes at least once in their lifetime[1]. Diagnosis of Acute pyelonephritis is usually made clinically based on signs and symptoms of fever, flank pain, dysuria etc[2]. CT abdomen helps in establishing a precise diagnosis by providing information on the nature and extent of the inflammation and the associated complications[3]. The commonest finding on CT abdomen in patients with acute pyelonephritis is wedge-shaped hypoperfusion[4]. While the uncommon finding on CT abdomen in pyelonephritis include perinephric fat infiltration, ureteral wall edema, renal abscess, pelvic ascites and renal scarring[5]. According to the consensus reached for defining complicated versus uncomplicated pyelonephritis, complicated pyelonephritis refers to the presence of systemic or anatomical predisposing factors, while uncomplicated pyelonephritis refers to the absence of systemic or anatomical factors[6]. To identify early prognostic markers and to prevent morbidity and mortality, it is essential to define clinical, biochemical and radiological profiles of patients with Acute pyelonephritis. Therefore, present study was aimed to correlate the clinical and biochemical parameters with radiological findings among patients with pyelonephritis.

MATERIALS AND METHODS

Present study was single-center, prospective, observational study, conducted in department of General Medicine, Karnataka Institute of Medical Sciences, Hubballi, India. Study duration was of 2 years (July 2018 to June 2019). Study was approved by institutional ethical committee.

Inclusion Criteria:
- Patients aged >18 Years, diagnosed with Acute Pyelonephritis, willing to participate in present study.

Exclusion Criteria: Patients with inflammatory conditions other than pyelonephritis, including:
- Patients who underwent urological intervention.
- History of trauma.
- Malignancies.

Study was explained to participants in local language and written informed consent was taken. Acute pyelonephritis said to be present when patient complained of fever with chills and rigors, flank pain, nausea and vomiting. USG KUB studies suggestive of pyelonephritis if there was a combination of enlarged kidney, presence of collection and perinephric fat stranding. Following investigations were done in the selected patients such as Complete blood count, Renal function test (blood urea and serum creatinine), Serum electrolytes (sodium, potassium), Urine routine, Urine Culture and Sensitivity, HIV, HBsAg (HCV, if required), Ultrasonography- Kidney, Ureter and Bladder, Contrast Enhanced Computed Tomography- Kidney Ureter and Bladder, Blood sugar level and HbA1C level.

Based on CT scan (when necessary), patients with emphysematous pyelonephritis can be classified into the following classes:
- **Class 1:** Gas in the collecting system only.
- **Class 2:** Gas in the renal parenchyma without extension to the extra-renal space.
- **Class 3:**
- **Class 3A:** Extension of gas or abscess to the perinephric space.
- **Class 3B:** Extension of gas or abscess to the pararenal space.
- **Class 4:** Bilateral EPN or solitary kidney with EPN.

Patients were treated with antibiotic as per culture sensitivity reports. Patients with NEPN were treated with parenteral antibiotics for 1 week followed by oral antibiotics for 2 weeks and EPN patients received antibiotics for at least 3 weeks. Patients with fungal UTI were initially treated with fluconazole/itraconazole for Candida species and amphotericin for non-candida species and changed as per culture sensitivity and continued for 2 weeks. Percutaneous drainage (PCD) with pigtail or percutaneous nephrostomy tube was inserted into pelvis or perirenal space to drain out fluid collection/gas in addition to antibiotics. Nephrectomy was carried out in patients refractory to antibiotics, PCN and/or clinical deterioration. Patients were divided into "good" and "poor" outcome groups to elucidate the risk factors. The patients who were successfully treated with antibiotics alone or with PCN were assigned to "good" outcome group. Those who had nephrectomy or died were classified as "poor" outcome group. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value <0.5 was considered as statistically significant.

RESULTS AND DISCUSSIONS

A total of 107 patients were included in the study, with mean age of 48.86 years and majority patients were from >40 years age group (72%). There was female gender predominance with 59 females (55.1%) and 48 males. Common comorbidities were diabetes mellitus (59.8%), hypertension (24.3%), renal calculi (14.0%) and recurrent pyelonephritis (2.8%). 28(26.2%) of the participants had Other Comorbidities like stroke, ischemic heart disease, heart failure, chronic pancreatitis etc.

Table 1: General Characteristics

Characteristics	No. of subjects	Percentage
Age group (in years)		
<40 Years	30	28%
>40 Years	77	72%
Mean age (in years)	48.86 ± 14.79	
Gender		
Male	48	44.9%
Female	59	55.1%
Comorbidities		
Diabetes Mellitus	64	59.8%
Hypertension	26	24.3%
Renal calculi	15	14.0%
Recurrent pyelonephritis	3	2.8%
Other comorbidities	28	26.2%

66 (61.7%) of the participants had Fever±Chills. 96(89.7%) of the participants had Flank Pain. 54 (50.5%) of the participants had Dysuria. 33 (30.8%) of the participants had Triad of Fever/Flank Pain/Dysuria. 41.1% of the participants had Vomiting.

Table 2: Presenting Symptoms

Presenting symptoms	Frequency	Percentage
Fever ± chills	66	61.7%
Flank pain	96	89.7%
Dysuria	54	50.5%
Triad of fever, flank pain and dysuria	33	30.8%
Vomiting	44	41.1%
Breathlessness	4	3.7%
Generalised Weakness	3	2.8%
Reduced Urine Output	3	2.8%
Right Lower Limb Pain	1	0.9%
B/L Lower Limb Swelling	1	0.9%
Giddiness	1	0.9%
Hematuria	1	0.9%
Pyuria	1	0.9%
Reduced Appetite	1	0.9%

8 (7.5%) of the participants had Septic Shock. 8 (7.5%) of the participants had low Platelet Count. 36 (33.6%) of the participants had Renal Function: Normal. 58 (54.2%) of the participants had Renal Function: AKI. 13 (12.1%) of the participants had Renal Function: CKD. 80 (74.8%) of the participants had urinary Pus cells >5/HPF 5 (4.7%) of the participants had urinary RBC >5/HPF, 83 (77.6%) of the participants had Positive Urine Culture:

Table 3: Laboratory Findings

Characteristics	No. of subjects	Percentage
Septic Shock	8	7.5%
Low Platelet Count (<150 x10³/mm³)	8	7.5%
Renal Function		
Normal	36	33.6%
AKI	58	54.2%
CKD	13	12.1%
Urine Microscopy findings		
Pus Cells >5/HPF	80	74.8%
RBC >5/HPF	5	4.7%
Positive Urine Culture	83	77.6%

83.1% of the participants had E. Coli, 1.2% of the participants had Enterococci, 4.8% of the participants had K. Pneumoniae, 3.6% of the participants had Non Albican Candida, 2.4% of the participants had Coagulase Negative Staphylococci, 2.4% of the

participants had Non-Fermenting Gram-Negative Bacilli and 2.4% of the participants had Candida Species.

Table 4: Organism Isolated in Urine Culture

Urine Culture: Organism Isolated	Frequency	Percentage
E. Coli	69	83.1%
Enterococci	1	1.2%
K. Pneumoniae	4	4.8%
Non Albican Candida	3	3.6%
Coagulase Negative Staphylococci	2	2.4%
Non-Fermenting Gram-Negative Bacilli	2	2.4%
Candida Species	2	2.4%

Majority organisms were sensitive to Amikacin/Gentamycin (75.9%) followed by Imipenem (72.3%), Meropenem (68.7%), Piperacillin-Tazobactam (48.2%) and Aztreonam 36 (43.4%).

Table 5: Urine Culture: Antibiotic Sensitivity

Urine Culture: Antibiotic sensitivity	N (%)
Amikacin/Gentamycin (Yes)	63 (75.9%)
Imipenem (Yes)	60 (72.3%)
Meropenem (Yes)	57 (68.7%)
Piperacillin-Tazobactam (Yes)	40 (48.2%)
Aztreonam (Yes)	36 (43.4%)
Ceftriaxone (Yes)	10 (12.0%)
Levofloxacin (Yes)	26 (31.3%)
Linezolid (Yes)	3 (3.6%)
Itraconazole (Yes)	5 (6.0%)
Others (Yes)	9 (10.8%)

On USG abdomen, common findings were enlarged kidney(s) with raised echotexture (99.1%) followed by dilated pelvicalyceal system (18.7%), calculi (15.0%), hydroureteronephrosis (15.0%) and air foci (7.5%).

Table 6: Summary of 'USG Abdomen and Pelvis Findings'

USG Abdomen and Pelvis Findings	No. of subjects (%)
Enlarged Kidney(s) with Raised Echotexture	106 (99.1%)
Dilated Pelvicalyceal System	20 (18.7%)
Calculi	16 (15.0%)
Hydroureteronephrosis	16 (15.0%)
Air Foci	8 (7.5%)
Cyst	2 (1.9%)
Normal	1 (0.9%)

On: CT-KUB, common findings were bulky kidney(s) with perinephric fat stranding (99.1%) followed by air foci (29.0%), dilated pelvicalyceal system (22.4%), hydroureteronephrosis (16.8%) and calculi (15.0%).

Table 7: CT-KUB Findings

CT-KUB Findings	No. of subjects (%)
Bulky Kidney(s) with Perinephric Fat Stranding+	106 (99.1%)
Air Foci	31 (29.0%)
Dilated Pelvicalyceal System	24 (22.4%)
Hydroureteronephrosis	18 (16.8%)
Calculi	16 (15.0%)
Hypoechoic Lesion	10 (9.3%)
Thinned Out Cortex With loss of Corticomedullary Differentiation	4 (3.7%)
Cyst	2 (1.9%)
Normal	1 (0.9%)
BPH	0 (0.0%)

9.3% of the Participants had Renal Abscess: 29.0% of the participants had Emphysematous Pyelonephritis (n=31). 48.4% of the participants had Grade of Emphysematous Pyelonephritis: I. 48.4% of the

participants had Grade of Emphysematous Pyelonephritis: II. 3.2% of the participants had Grade of Emphysematous Pyelonephritis: IIIA. USG/CT Abdomen 29.9% of the participants had Right sided pyelonephritis, 38.3% of the participants had Left sided Pyelonephritis, 31.8% of the participants had Bilateral Pyelonephritis. The mean (SD) of Duration of Hospital Stay (Days) was 11.71±5.86 days.

Table 8: Other Characteristics

Characteristics	No. of subjects	Percentage
Renal Abscess	10	9.3%
Grade of Emphysematous Pyelonephritis (n=31)		
I	15	48.4%
II	15	48.4%
IIIA	1	3.2%
USG Abdomen/CT Abdomen: Pyelonephritis Laterality		
Right	32	29.9%
Left	41	38.3%
Bilateral	34	31.8%

71 (66.4%) of the participants had no intervention other than antibiotics, 24 (22.4%) of the participants underwent DJ Stenting, 14 (13.1%) of the participants underwent Hemodialysis, 4 (3.7%) of the participants underwent Percutaneous Nephrostomy, 2 (1.9%) of the participants underwent Per cutaneous Nephrolithotomy.

Table 9: Intervention Other than Antibiotics

Intervention Other Than Antibiotics	No. of subjects (%)
None	71 (66.4%)
DJ Stenting	24 (22.4%)
Hemodialysis	14 (13.1%)
Percutaneous Nephrostomy	4 (3.7%)
Percutaneous Nephrolithotomy	2 (1.9%)

96.3% of the participants had Recovered while 3.7% of the participants died.

Table 10: Outcome

Outcome	Frequency	Percentage
Recovered	103	96.3%
Died	4	3.7%

There was a significant difference between Fever Duration (Days) (W=568.500, p=0.011), with the median Fever Duration (Days) being highest in the CT-KUB Finding. There was a significant difference in Leukocytosis Duration (Days) (W=979.000, p=0.011), with the median Leukocytosis Duration (Days) being highest in the CT-KUB Finding: Air Foci. There was a significant difference CRP (mg/L) (W=1692.500, p=<0.001), with the median CRP (mg/L) being highest in the CT-KUB Finding: Air Foci, There was a significant difference between Duration of Hospital Stay (Days) (W=1691.500, p=<0.001), with the median Duration of Hospital Stay (Days) being highest in the CT-KUB Finding: Air Foci. There was a significant difference between Dysuria ($\chi2=4.097$, p=0.043) and hydroureteronephrosis, had the larger proportion

(72%) of Dysuria. There was a significant difference between Triad of Fever/Flank Pain/Dysuria ($\chi2= 6.197$, p=0.013) and Hydroureteronephrosis, had the larger proportion (55.6%) of Triad of Fever/Flank Pain/Dysuria. Among patients with Calculi,1 (12.5%) patient had grade I EPN, 7 (87.5%) patients had grade II EPN. There was a significant difference between the various groups in terms of distribution of Grade of Emphysematous Pyelonephritis ($\chi2=6.627$, p=0.047). There was a significant difference between Fever Duration (Days) (W=568.500, p=0.011), with the median Fever Duration (Days) being highest in the Emphysematous Pyelonephritis. There was a significant difference between Leukocytosis Duration (Days) (W = 979.000, p=0.011), with the median Leukocytosis Duration (Days) being highest in the Emphysematous Pyelonephritis. There was a significant difference between CRP (mg/L) (W=1692.500, p=<0.001), with the median CRP (mg/L) being highest in the Emphysematous Pyelonephritis. There was a significant difference between Duration of Hospital Stay (Days) (W=1691.500, p=<0.001), with the median Duration of Hospital Stay (Days) being highest in the Emphysematous Pyelonephritis: Yes group. There was a significant difference between the 3 groups in terms of CRP (mg/L) ($\chi2=9.443$, p=0.009), with the median CRP (mg/L) being highest in the USG Abdomen/CT Abdomen: Pyelonephritis Laterality: Bilateral group. There was a significant difference between the 3 groups in terms of Duration of Hospital Stay (Days) ($\chi2=10.092$, p=0.006), with the median Duration of Hospital Stay (Days) being highest in the USG Abdomen/CT Abdomen: Pyelonephritis Laterality: Bilateral group.

Our study is a single center, prospective observational study, with the objective of find the clinical profile and microbial spectrum of acute pyelonephritis ant to compare them with the radiological abnormalities of acute pyelonephritis. Among the 107 participants in present study, the mean age of patients in was 48.86 years, majority of them were >40 years of age. In Venkatesh[7] study., the mean age of patients was 48.7 years, majority >60 years of age. In Kim[8] study., the mean age of patients was 42.8 years, majority >40 years of age. In Paick[9] study., the mean age of patients was 39.3 years, majority >30 years of age. In Lim[10] study., the mean age of the patients was 52.13 years, majority >40 years of age. The Present study was most comparable to Venkatesh L *et al.* study., in terms of mean age of patients in years. In the present study, patients above 40 years of age had highest mean duration of hospital stay and higher proportion of hydroureteronephrosis, CKD and bilateral pyelonephritis (p=<0.001, p=0.029, p=<0.001 and p=<0.001 respectively). Prevalence of pyelonephritis was more common among females in this study and

Table 11: Association Between CT-KUB Finding: Air Foci and Clinical Parameters

	CT-KUB Finding: Air Foci		Wilcoxon-Mann- Whitney U Test	
	Yes Mean (SD)	No Mean (SD)	W	p value
Fever Duration (Days)	12.62 (8.59)	7.42 (5.81)	568.500	0.011
Leukocytes Duration (Days)	7.48 (2.42)	5.91 (3.20)	979.000	0.011
CRP (mg/L)	71.87 (18.55)	55.16 (22.47)	1692.500	<0.001
Duration of Hospital Stay (Days)	14.90 (6.93)	10.41 (4.84)	1691.500	<0.001

Table 12: Association Between CT-KUB- Hydroureteronephrosis and Clinical Parameters

	CT-KUB Finding: Hydroureteronephrosis			Chi-Squared Test	
	Yes	No	Total	χ^2	P-Value
Dysuria	13 (72.2%)	41 (46.1%)	54 (50.5%)	4.097	0.043
Triad of Fever/Flank Pain/Dysuria	10 (55.6%)	23 (25.8%)	33 (30.8%)	6.197	0.013

Table 13: Association Between CT-KUB-Calculi and Grade of Emphysematous Pyelonephritis'

Grade of Emphysematous Pyelonephritis	CT-KUB Finding: Calculi			Fisher's Exact Test	
	Yes	No	Total	χ^2	P Value
I	1 (12.5%)	14 (60.9%)	15 (48.4%)	6.627	0.047
II	7 (87.5%)	8 (34.8%)	15 (48.4%)		
IIIA	0 (0.0%)	1 (4.3%)	1 (3.2%)		
Total	8 (100.0%)	23 (100.0%)	31 (100.0%)		

Table 14: Association Between Emphysematous Pyelonephritis and Clinical Parameters

	Emphysematous Pyelonephritis		Wilcoxon-Mann- Whitney U Test	
	Yes Mean (SD)	No Mean (SD)	W	p value
Fever Duration (Days)	12.62 (8.59)	7.42 (5.81)	568.500	0.011
Leukocytosis Duration (Days)	7.48 (2.42)	5.91 (3.20)	979.000	0.011
CRP (mg/L)	71.87 (18.55)	55.16 (22.47)	1692.500	<0.001
Duration of Hospital Stay (Days)	Mean (SD)	14.90 (6.93)	10.41 (4.84)	1691.500

Table 15: Association Between USG Abdomen/CT Abdomen: Pyelonephritis Laterality and Clinical Parameters

	USG Abdomen/CT Abdomen: Pyelonephritis Laterality			Kruskal Wallis Test	
	Right	Left	Bilateral	χ^2	p value
CRP (mg/L)	56.00 (21.60)	55.37 (23.45)	69.35 (20.24)	9.443	0.009
Duration of Hospital Stay (Days)	10.66 (6.52)	10.61 (4.15)	14.03 (6.45)	10.092	0.006

this finding was similar to Venkatesh[7] study., Kim[8] study., Paick[9] study and Lim[10] study. The Present study was comparable to Venkatesh[7] study., in terms of gender distribution, with more prevalence of females. This could be explained by the short distance between urethra and anal canal in females. In the present study, the mean duration of fever (days) was 8.68±6.90 days. It was 7.3±3.1 days in Kim[8] study., 1.6±1.0 days in Paick[9] study., 3.66 ± 0.6 days in Lim[10] study. The present study was comparable to Kim[8] study., in terms of mean duration of fever (days). In the present study, the mean duration of Leukocytosis (days) was 6.39±3.06 days. It was 3.5±1.2 days in Paick[9] study. Other comparable studies did not include mean duration of Leukocytosis in their methodology. Mean duration of Leukocytosis was higher in our study compared to the same in Paick[9] study. The duration of leukocytosis was longer in patients with diabetes, CKD and those on hemodialysis. In the present study, the mean duration of hospital stay was 11.71±5.86 days. It was 6.8 days in Venkatesh[7] study., 6.5±1.7 days in Paick[9] study., 9.8±1.3 days in Lim[10] study. The present study was comparable to Lim[10] study., in terms of mean duration of hospital stay, in days. Longer duration of

leukocytosis, high CRP levels and high sr. creatinine levels were associated with longer duration of hospital stay, in present study. In the present study, septic shock was present in 8 (7.5%) patients. It was present in 7 (7%) participants in Venkatesh[7] study., 28 (21.53%) participants in Lim[8] study. In present study, septic shock was significantly associated with diabetes, higher CRP levels, renal impairment, emphysematous pyelonephritis and increased mortality. 4 out of 8 patients with septic shock died, in present study. In the present study, the most common CT finding was bulky kidney with perinephric fat stranding, which was observed in 106 (99.1%) patients. It was 66 (66%) in Venkatesh[7] study., 69 (55%) in Kim[8] study., 204 (100%) Paick[9] study., 130 (100%) in Lim[10] study. In the present study, presence of air foci on CT was observed in 31 (29.0%) patients. It was 4 (4%) in Venkatesh[7] study. Compared to Venkatesh[7] study, the presence of air foci on CT among the patients was significantly higher in present study. In the present study, presence of dilated pelvicalyceal system on CT was observed in 24 (22.4%) patients. It was 17 (17%) in Venkatesh[7] study. Compared to Venkatesh[7] study., the presence of dilated pelvicalyceal system on CT among the patients was higher in present study. In the present

study, presence of cyst on CT was observed in 2 (1.9%) patients. It was 2 (2%) in Venkatesh L *et al.* study. Present study was comparable to Venkatesh *et al.* study in terms of presence of cyst on CT. In the present study, presence of calculi on CT was observed in 16 (15.0%) patients. It was 15 (15%) in Venkatesh[7] study. and 21 (16.15%) in Lim SK *et al.* study. Present study was most comparable to Venkatesh *et al.* study in terms of presence of calculi on CT. Patients with renal calculi are more likely to develop emphysematous pyelonephritis (p=0.047). In the present study, the duration of fever (days), leukocytosis duration (days), CRP (mg/l) and duration of hospital stay (days) were significantly higher in cases with air foci on CT-KUB (p=0.011, p=0.011, p=<0.001 and p=<0.001 respectively). Study done by Kim[8] found the cases with perirenal fat stranding on CT had higher values of fever duration, CRP level and grade of pyuria (p=0.010, p=0.033 and p=0.049, respectively) and CRP level was significantly higher in patients with renal abscess and ureteral wall edema (p=0.005 and p=0.015, respectively). In the present study, the duration of fever (days), leukocytosis duration (days) and duration of hospital stay (days) were significantly higher in cases with air foci on CT-KUB (p=0.011, p=0.011 and p=<0.001 respectively). In Paick[9] study., the mean hospital stay, fever duration and Leukocytosis duration increased with APN grade from 1-4 (p=<0.001, p=0.005 and p=0.039 respectively). The present study was comparable to the study done by Paick SH *et al.* in terms of duration of fever (days), leukocytosis duration (days) and duration of hospital stay (days) compared to severity of disease. CT findings can help in detecting renal abscess, calculi, emphysematous pyelonephritis etc., which may be missed by ultrasound and help in creating a treatment plan for these complications. Patients with advanced age, severe disease, hypotension, renal impairment and severe form of pyelonephritis on imaging carry poor prognosis. Limitations of present study were small sample size, single center study and longer follow up to evaluate recurrence and treatment failure could not be obtained.

CONCLUSION

Present study showed a good correlation between clinical, biochemical and radiological parameters in patients with acute pyelonephritis and these parameters can help in predicting the severity and clinical course of the disease. Clinical parameters in the form of duration of leukocytosis, fever and hospital stay along with biochemical parameters in the form of total WBC counts and CRP levels correlate with disease severity. Although clinical triad of pyelonephritis comprising of fever, flank pain and dysuria is classical of pyelonephritis, it is not always present in all patients

with the disease and is neither sensitive nor specific. CT is a better alternative for the early diagnosis of pyelonephritis.

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